REMARKS

Formal drawings are submitted herewith under separate Letter to the Official Draftsperson. No other changes have been made. Approval by the Examiner is respectfully requested.

Claims 1-9 were rejected under 35 U.S.C. § 102(e) as being anticipated by Ma et al. (US 6,916,554).

Claim 1 is the only independent claim in this group of claims and so it will be briefly reviewed and then discussed in more detail.

Claim 1 sets forth an organic light-emitting device having an anode, a hole-transporting layer and a stability-enhancing layer in contact with the light-emitting layer. The stability-enhancing layer includes at least one host and one inorganic dopant. An electron-transporting layer is disposed over the stability-enhancing layer and the cathode is disposed over the electron transporting layer. This particular arrangement provides advantages such as increasing the operational stability moreover, this stability-enhancing layer can operate at a lower drive voltage as compared to conventional devices.

In order to permit ease of reading but without implying any limitations of the claims, applicants have inserted reference numerals to facilitate the Examiner's comparison between references and the claimed invention.

In the present invention, there are several criteria necessary for a layer to qualify as the claimed stability-enhancing layer. This layer must be disposed in contact with the light-emitting layer and is not in contact with cathode. There should be an electron-transporting layer 138 between the "stability-enhancing layer 236" and the cathode 140. The stability-enhancing layer has to include at least one organic host material and one inorganic dopant material.

It should be noted that claim 3 adds the feature that the ionization potential of the host material in the stability-enhancing layer is equal to or less than the ionization potential of the host material in the light-emitting layer.

The Examiner in discussing Ma et al. on page 2 of the Office Action, relates the claimed "stability-enhancing layer 236" to the "hole blocking layer 140" of Ma et al.'s patent (US Pat No. 6,916,554). There is a numbering mistake in Ma et al.'s patent. Ma et al. call layer 140 the "Electron transport layer 140". In column 6, at line 18, Ma et al. refer to layer 140 as the hole blocking layer and the electron transport layer is referred to as 145. This is correct. Later in column 6 Ma et al. labels layer 140 as an electron transport layer. See lines 21-22.

First, we need to clarify that the paragraph in Column 5, lines 47-56, should discuss "electron transport layer 145" instead of "hole blocking layer 140". 1) Ma et al. indicate in Column 6, lines 18-23: "Similarly, a hole blocking layer 140 may be disposed between emissive layer 135 and electron transport layer 145, to block holes from leaving emissive layer 135 in the direction of electron transport layer 140." This should have indicated "in the direction of electron transport layer 145". Therefore, "electron transport layer 140" that appears in Column 5, lines 47 and 49 should have been referred to as "electron transport layer 145". 2) If the paragraph in Column 5, lines 47-56 were to discuss "hole blocking layer 140", this layer could not be an n-doped electron transport layer. US Pat. Appl. No. 2003/0230980, which is cited as a reference in its entirety in Ma et al.'s patent, discloses that "blocking layers are not doped to enhance their conductivity. Doping these layers in such a manner may allow the dopant in question to diffuse into the emissive layer, where it may quench excitons and reduce device efficiency." (Page 1, Paragraph [0034]). The layer discussed in the paragraph in Column 5, lines 47-56 of Ma et al.'s patent involves n-type doping, and is clearly an electron transport layer 145. Therefore, Ma et al. indeed discuss their electron transport layer 145, instead of hole blocking layer 140, in the paragraph in Column 5, lines 47-56. This "electron transport layer 145", which is disposed between hole blocking layer 140 and electron injection layer 150, is similar to the claimed "electron-transporting layer 138" in Fig 2.

Claim 1 requires that the "stability-enhancing layer 236" must be disposed in contact with the light-emitting layer 134". However, the

"electron transport layer 145" in Ma et al.'s patent is disposed in contact with their hole blocking layer 140 and is separated from their emissive layer 135. Therefore, judging from the layer position, it is clear that the claimed "stability-enhancing layer 236" is not the same as the electron transport layer 145 as discussed in Column 5, lines 47-56 of Ma et al.'s patent.

Secondly, the claimed "stability-enhancing layer 236" is not the same as a hole blocking layer in Ma et al.'s patent or in other prior art. Although both the claimed "stability-enhancing layer 236" and the hole blocking layer in Ma et al.'s patent or in other prior art have the same layer position, i.e. they are disposed in contact to the emissive layer (or light-emitting layer), their functions are different: 1) As a hole blocking layer, the band gap is wider than that of the emissive layer (Page 1, Paragraph [0033], in US Pat. Appl. No. 2003/0230980, cited by Ma et al). In other words, in order to fully block both exitons and holes, the ionization potential of the hole blocking layer 140 is greater than the ionization potential of the host material in the light-emitting layer. In order to enhance the stability of the OLED, the claimed "stability-enhancing layer 236" has to be doped with at least one inorganic dopant material. However, a hole blocking layer is not doped with an inorganic dopant material as disclosed by prior art. Therefore, the claimed "stability-enhancing layer 236" is not the same as a hole blocking layer.

Accordingly, Applicants believe that Ma et al. in US Pat No. 6,916,554, do not disclose, suggest, or provide any motivation for the subject matter of claim 1. Although the remaining claims 2-9 are in dependent format and should be allowed along with claim 1, they further set forth important features of the present invention.

Claims 10, 11, 15, 16, 22-32 and 36-37 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ma et al. (US Pat. No. 6,916,554) and further in view of Leung et al. (US Pat. No. 2004/0124767).

Claim 22 is the only independent claim in this group of claims. It is quite similar to claim 1 and so all the remarks made above with respect to claim 1 apply to claim 22. The above discussion to Ma et al. applies equally to claims 1 and 22 and so Ma et al. need not be discussed further.

The composition of the metal doped layer 105 in the Leung et al. patent application, is the main feature of their invention (Page 2, Paragraph [0035]). Leung et al. use this metal doped layer as an improved *electron injection layer (called metal doped layer 105), which is always disposed in contact with cathode 106* no mater how complicated the device layer structure is (see Figs. 1-6), to replace the prior art electron injection layer because in the prior art "although the electron injection layer formed by co-deposition of a metal having a low work function and an organic compound having electron withdrawing group can reduce the driving voltage of OLED, the stability and efficiency of the diodes are still not enough" (Page 1, Paragraph [0011]). However, in the present invention as set forth in claims 1 and 22, the "stability-enhancing layer 236" is always disposed in contact with the light-emitting layer and never in contact with a cathode. It is therefore quite clear that the layer structure of claimed "stability-enhancing layer 236" is not the same as that of the metal doped layer 105 in Leung et al.'s patent application. Moreover, the Leung et al. metal doped layer 105 provides a different function than the claimed stability-enhancing layer.

The organic compounds represented by a formula (1) of Leung et al. and specifically listed as formulas (2)-(18) in US 2004/0124767 A1 contain oxadiazole groups which are wide band gap materials with a large electron affinity (can be greater than 4.5 eV) and a large ionization potential (can be greater than 8.0 eV). (Please see some of the references: OXD compounds in J. Phys. Chem. A 101, 2350 (1997) by Naito et al.; and (FO)n polymers in J. Phys. Chem. A 109, 7764 (2005) by Yang et al.) Since the electron affinity is significantly greater than conventional electron transport materials, the oxadiazole materials are suitable for use in forming an electron injection layer with either no or a low electron injection barrier between the cathode and this novel electron injection layer. In considering that the oxadiazole derivatives as claimed by Leung et al. will have large electron affinities, one skilled in the art will clearly expect that the doped metals have a work function up to 4.5 eV. These materials can not be used in the claimed stability-enhancing layer.

The reason for this is that a conventional electron transport material can not be doped with a metal having a work function higher than 4.0 eV due its relatively low electron affinity. In considering the aforementioned property, the organic compounds represented by formula (1) are not electron transport materials. Leung et al. do not consider their invented materials as electron transport materials.

The host material in the claimed "stability-enhancing layer 236" is selected from electron-transporting materials (our claims 2, 4, 5, 17, 23, 25, 26, and 38). Therefore, the composition of the claimed "stability-enhancing layer 236" is also different from the composition of the metal doped layer 105 in Leung et al.'s patent application.

If the metal doped layer 105 in Leung et al.'s patent application were to be used as a layer in contact with the light-emitting layer, similar to the claimed "stability-enhancing layer 236", it would be ineffective to satisfactorily to inject electrons from the metal doped layer into the light-emitting layer due the large electron affinity of the metal doped layer (or very low LUMO position). Moreover, there would be a severe hole blocking effect due to the greater ionization potential of the metal doped layer than the ionization of the host material in the light-emitting layer. The ionization potential of a typical material from formula (1) can be roughly estimated as follows. Since the metal having a work function of 4.5 eV could be doped into a material represented by formula (1), the electron affinity of the material represented by formula (1) should be greater than or equal to 4.5 eV. As an electron transporting material, the optical band gap should be at least higher than 2.5 eV. Therefore, the ionization potential of the electron transporting material should be greater than 7.0 eV. However, usually the ionization potential of the host material in a light-emitting layer is less than 5.9 eV. Considering an extreme case, a host material in the light-emitting layer of a phosphorescent OLED, called CBP, has an ionization potential of about 6.3 eV, which is still less than 7.0 eV (see, Applied Physics Letters, 75, 4 (1999)). The OLED based on this structure would have very high drive voltage and very low operational stability. However, as set forth in claims 3 and 24, the

ionization potential of the host material in the stability-enhancing layer is equal to or less than the ionization potential of the host material in the light-emitting layer.

Therefore, in terms of layer position (or layer structure), layer composition, and device performance, it is believed that there is no similarity between the claimed "stability-enhancing layer 236" in claims 1 and 22 and the metal doped layer 105 in Leung' patent application, and it is not proper to use Leung et al.'s as well as Ma et al.'s patents against the present invention.

Claims 12, 13 and 14, were rejected under 35 USC § 103(a) as being unpatentable over Ma et al. (US Pat. No. 6,916,554) as applied to claims 1 and 6 above, and further in view of Tokito et al. (US Pat. No. 5,783,292). Claim 17 was rejected under 35 USC § 103(a) as being unpatentable over Ma et al. (US Pat. No. 6,916,554) as applied to claim 1 above, and further in view of Parthasarathy et al. (US Pat. No. 6,885,149). Claims 18-21 were rejected under 35 USC § 103(a) as being unpatentable over Ma et al. (US Pat. No. 6,916,554) as applied to claim 1 above, and further in view of Hamada et al. (US Pat. No. 6,921,590). Claims 33, 34 and 35 were rejected under 35 USC § 103(a) as being unpatentable over Ma et al. (US Pat. No. 6,916,554) and Leung et al. (US Pat. No. 2004/0124767) as applied to claims 22 and 27 above, and further in view of Tokito et al. (US Pat. No. 5,783,292). Claim 38 was rejected under 35 USC § 103(a) as being unpatentable over Ma et al. (US Pat. No. 6,916,554) and Leung et al. (US Pat. No. 2004/0124767) as applied to claim 22 above, and further in view of Parthasarathy et al. (US Pat. No. 6,885,149). Claims 39-42 were rejected under 35 USC § 103(a) as being unpatentable over Ma et al. (US Pat. No. 6,916,554) and Leung et al. (US Pat. No. 2004/0124767) as applied to claim 22 above, and further in view of Hamada et al. (US Pat. No. 6,921,590).

Since all of the above listed claims depend upon either claims 1 or 22, they should also be allowed.

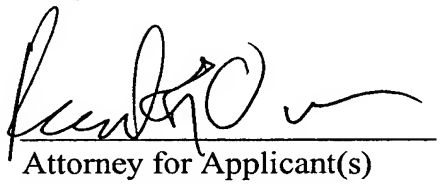
Nevertheless, applicants note that the claimed "stability-enhancing layer 236" in claims 1 and 22 is totally different from Ma et al.'s electron transport layer 145 and hole blocking layer 140 in US Pat. No.

6,916,554, and totally different from Leung et al.'s metal doped layer 105 in US 2004/0124767 A1. Therefore, taking any combination of Ma et al.'s and Leung et al.'s inventions, along with Tokito et al.'s invention (US Pat. No. 5,783,292), or Parthasarathy et al.'s invention (US Pat. No. 6,885,149), or Hamada et al.'s invention (US Pat. No. 6,921,590) is not reasonable since Tokito et al., Parthasarathy et al. and Hamada et al. do not in any way disclose or suggest the claimed stability-enhancing layer.

In summary, the stability-enhancing layer in the present invention is different from the electron transport layer and the hole blocking layer in the prior art. The claimed stability-enhancing layer can effectively increase the operational lifetime of OLEDs, and has not been disclosed or suggested by any of the cited art.

In view of the foregoing, it is believed none of the references, taken singly or in combination, disclose the claimed invention. Accordingly, this application is believed to be in condition for allowance, the notice of which is respectfully requested.

Respectfully submitted,



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If the Examiner is unable to reach the Applicant(s) Attorney at the telephone number provided, the Examiner is requested to communicate with Eastman Kodak Company Patent Operations at (585) 477-4656.

Amendments to the Drawings:

Replacement sheets for FIGS. 1-4 are enclosed which formalize the drawings that were submitted with the application. No other changes have been made. Formal drawings are submitted herewith under separate Letter to the Official Draftsperson. Approval by the Examiner is respectfully requested.